

Rhinolophus hildebrandti. By David L. Pearl

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Rhinolophus hildebrandti Peters, 1878

Hildebrandt's Horseshoe Bat

Rhinolophus hildebrandti Peters, 1878:194. Type locality "Ndi, Taita" (the Taita district in Kenya).

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Rhinolophidae, Subfamily Rhinolophinae, Genus *Rhinolophus*. There are no recognized subspecies of *R. hildebrandti* (Hayman and Hill, 1971; Koopman, 1993).

DIAGNOSIS. Hildebrandt's horseshoe bat is the largest species of the genus in Africa, characterized by a forearm >62 mm in length. The anterior horseshoe portion of the noseleaf is >9 mm, the sella is straight sided with a round top, and the profile of the connecting process is short and rounded. The anterior upper premolar, when present, is minute and outside the toothrow (Roberts, 1951).

GENERAL CHARACTERS. The dorsum is greyish-brown, and the venter is similar but paler (Fig. 1). The pelage is long and soft. The wing and interfemoral membranes are a translucent brown. The tail is enclosed within the interfemoral membrane. Like most members of the family, individuals roost with wings wrapped around the body and tails folded back over the rump. Nowak (1991) compared the appearance of a roosting rhinolophid to the pod of a fruit or the cocoon of an enormous insect. The ears of *R. hildebrandti* are large and pointed at the tips. They are strongly convex on their inner edges and concave on the outer. No tragus is present, but there is a prominent antitragus at the base of each ear. The ears of rhinolophids are capable of independent movement (Griffin et al., 1962). The face and the lateral margins of the sella of *R. hildebrandti* are liberally furnished with hairs. All females of the genus, in addition to two functional axillary teats, have an additional pair of false teats located just anterior to the genital orifice, which may function as a clinging point for the young (Skinner and Smithers, 1990).

The dental formula is $i\ 1/2$, $c\ 1/1$, $p\ 2/3$, $m\ 3/3$, total 32. In addition to the diagnostic position of the anterior premolar, *R. hildebrandti* often lacks the second lower premolar (identified as the third by Roberts, 1951). The upper incisors are small and found near the anterior outer border of the premaxilla (Fig. 2). They have a distinct rounded crown with a slight cusp on the inner side. The lower incisors are trifid. The upper canines are heavy and lack any secondary cusps. The lower canines are rather weak (Miller, 1907). M1 and M2 are without hypocone, and M3 has five cusps. The lower molars all have well-developed cusps. The sagittal crest extends nearly to the occiput. The auditory bullae are small and the cochlea large. Basisphenoid pits are absent. Skull measurements (mm) include ($n = 7$): condylocanine length, 26.8-27.7; zygomatic width, 13.1-14.0; width of brain case, 11.0-11.7; width of mastoid, 12.0-12.6; width across upper third molar, 9.4-10.4; width across upper canine, 8.5 (all seven specimens); canine to third upper molar, 9.3-10.3; canine to lower third molar, 10.2-11.0; mandible length plus incisor, 18.0-19.2 (Roberts, 1951).

The range of external measurements (mm) and body mass (g) for male and female *R. hildebrandti*, respectively, are: forearm, 62-66 ($n = 11$), 64-67 ($n = 9$); total length, 108-121 ($n = 15$), 109-125 ($n = 15$); length of tail, 32-40 ($n = 15$), 31-43 ($n = 15$); length of hindfoot, 13-16 ($n = 15$), 14-16 ($n = 15$); length of ear 30-33 ($n = 15$), 28-34 ($n = 15$); body mass, 22.8-33.2 ($n = 12$), 26-34 ($n = 8$; Smithers and Wilson, 1979). The range of measurements (mm) for the third, fourth, and fifth digit, respectively, are ($n = 7$): metacarpal, 44-48, 46-49, 46.5-50; first phalange, 21-22, 11.5-14, 14.5-16; second phalange, 33-38, 20-23, 18-21 (Roberts, 1951). In rhinolophids, the second digit

consists only of the metacarpal. The wings of *R. hildebrandti* are broad with a mean aspect ratio of 6.8 ($SD = 0.6$) and a mean wing loading of 9.8 N/m² ($SD = 1.3$; Fenton and Rautenbach, 1986). The toes each have three phalanges except the hallux which has two.

The shoulder girdle of *R. hildebrandti* is typical of rhinolophids. The seventh cervical vertebra and the first thoracic are fused; these are fused with the first rib, which is also fused with the presternum and the ventral half of the second rib (Miller, 1907; Walton and Walton, 1970). Hill and Smith (1984) noted that these fusions promote rigidity of the main body axis, which facilitates flight. The pelvis of *R. hildebrandti*, like that of all rhinolophids, shows a reduction in size of the pubis and ischium. As a result of this reduction, the obturator foramen is barely twice as large as the acetabulum (Miller, 1907; Walton and Walton, 1970).

DISTRIBUTION. *R. hildebrandti* is restricted to east Africa (Fig. 3). Although ranging as far south as Transvaal (South Africa), it is inexplicably absent from the western woodland regions of northern Botswana, Caprivi, and southeastern Angola (Rautenbach, 1982). Francistown in Botswana forms the western limit (Smithers, 1971); Kenya, Somalia, and Ethiopia are the most eastern localities recorded on the continent (Dorst and Prevost, 1971). *R. hildebrandti* is found as far north as the Sudan (Koopman, 1975).



FIG. 1. *Rhinolophus hildebrandti* photographed in Zimbabwe. Photograph courtesy of M. B. Fenton.



FIG. 2. Dorsal, ventral, and lateral views of the cranium, and lateral view of the mandible of a female *Rhinolophus hildebrandti* (Royal Ontario Museum 68504 from Maungu, Kenya). Greatest length is 24.6 mm. Photograph courtesy of M. B. Fenton.

In Mozambique this bat is found from the western Gaza and the Northern Inhamba to the northern Tete Districts (Smithers and Tello, 1976). *R. hildebrandti* is widely distributed throughout Zimbabwe (Smithers and Wilson, 1979), Malawi (Ansell and Dowsett, 1988), and Zambia (Ansell, 1978). In addition, Skinner and Smithers (1990) mentioned records from eastern Tanzania, Rwanda, Uganda, and eastern Zaire. There is no fossil record.

FORM AND FUNCTION. Rhinolophids emit echolocation pulses through their nostrils. This emission is facilitated by an epiglottis that fits into the nasolaryngeal hole of the soft palate to form a tightly sealed laryngonasal junction (Matsumura, 1979; Möhres, 1953). In other words, the larynx is coupled to the nasal cavities and the oral cavity is separated from the vocal tract. The echolocation calls of *R. hildebrandti* are characterized by a long (about 30 ms), narrow band component that dominates the call, followed by an FM sweep (bandwidth of about 16 kHz). Most of the energy in the call is found in the second harmonic at about 45 kHz (Fenton and Bell,

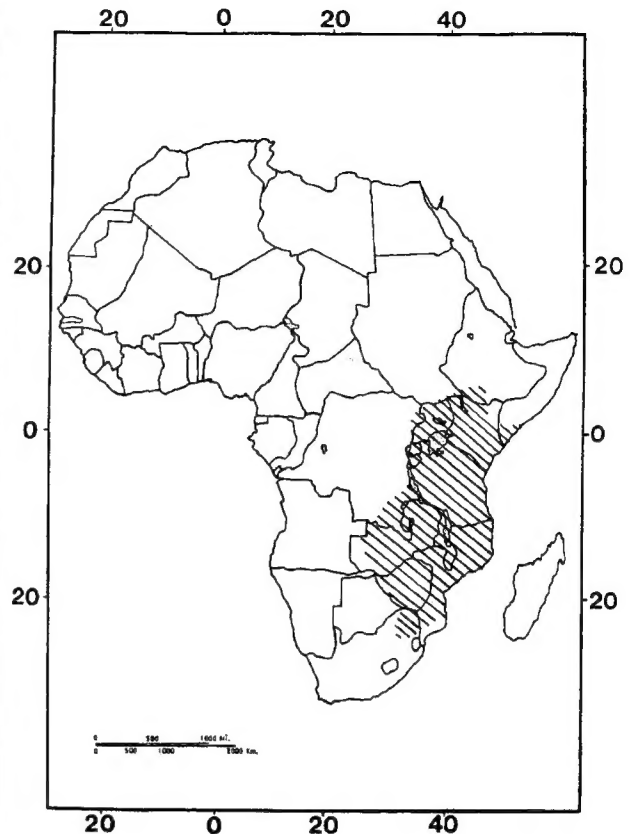


FIG. 3. Distribution of *Rhinolophus hildebrandti* in Africa (modified from Skinner and Smithers, 1990).

1981). The fundamental is typically suppressed 20 to 30 dB below the level of the second harmonic, and four harmonics have been recorded (Suthers et al., 1988). The noseleaf of rhinolophids serves to focus the ultrasonic calls in front of the animal (Möhres, 1953).

Typical of the genus, the skull is characterized by paired swellings on the dorsal side of the anterior part of the rostrum. These swellings form a dome-like structure situated above the nasal aperture. Hill and Smith (1984) suggested that the swellings might be associated with the emission of high frequency echolocation calls. Suthers et al. (1988) found that tracheal and nasal chambers suppressed the internally reflected and externally radiated components of the laryngeal fundamental. This suppression may allow *R. hildebrandti* to use the tissue-conducted fundamental as a reference for its laryngeally-generated sound. The reference may be an important aid in processing sonar information.

ONTOGENY AND REPRODUCTION. The reproductive behavior of *R. hildebrandti* remains largely unknown. Pregnant females have been recorded in late September and October (Anciaux de Faveaux, 1978; Skinner and Smithers, 1990; Smithers, 1971; Smithers and Wilson, 1979). Birth occurs in late November or December, which coincides with the warm, wet summer months (Anciaux de Faveaux, 1978; Pienaar et al., 1987; Skinner and Smithers, 1990). Ansell (1967) found a pair of juveniles (male and female) in June. In each bat the upper incisors had erupted. The male had both first and second lower incisors, but only the first lower incisors had erupted in the female. Females tend to give birth to a single young, but Anciaux de Faveaux (1978) captured a pregnant female with two fetuses, and suggested that reproduction occurred from August to September, implying a gestation period of about 3 months. Anciaux de Faveaux (1978) mentioned that colonies remain monosexual outside the reproductive season. Young are left behind in the day roost while their mothers forage (Pienaar et al., 1987).

ECOLOGY AND BEHAVIOR. The preferred habitat of *R. hildebrandti* is woodland savanna, although Ansell and Ansell (1973) recorded the species in "bracken-brier" near the head of a stream in a montane area. Roosts of *R. hildebrandti* have been

found in caves, mines, unused buildings, warthog holes, and hollow trees such as baobab, *Adansonia digitata*, and mopane, *Colophospermum mopane* (Pienaar et al., 1987). Day roosts typically are humid with a constant temperature cooler than the ambient temperature. Individuals hang from walls or the roof, and colonies usually consist of small clusters of individuals evenly separated. They are mostly found roosting in complete darkness, but sometimes in half light (Smithers and Wilson, 1979). The size of these colonies can be quite variable, ranging from a dozen to >100 (Smithers, 1971; Wilson, 1975). Horseshoe bats tend to be faithful to a roost and have been found to return to the same roost even after attacks by barn owls, *Tyto alba*, near the roost entrance (Fenton and Rautenbach, 1986). *R. hildebrandti* has been found roosting with *Hipposideros caffer* and *Miniopterus schreibersii* (Rautenbach, 1982).

R. hildebrandti is insectivorous and mixes moths and beetles in its diet (Fenton et al., 1977). Fenton and Rautenbach (1986) noted that *R. hildebrandti* forages both in continuous flight and in short flights from perches. At dusk, they emerge from the day roost and begin an intense period of solitary foraging while in flight (up to a period of 2 h). After this period they find a night roost in branches, groom, and continue to hunt in a manner similar to a flycatcher (Pienaar et al., 1987). They forage in zig-zagging flights through the woodland just above the ground. Wilson (1975) netted specimens over water in Hwange National Park, Zimbabwe.

With the exception of Fenton and Rautenbach (1986) observing attacks by barn owls, *Tyto alba*, on *R. hildebrandti*, there are no records of predation on the species. The only ectoparasite recorded on *R. hildebrandti* was a male flea, *Stylidia scissa rhodesiensis* (Ansell and Ansell, 1973).

GENETICS. Peterson and Nagorsen (1975) described the karyotype of *R. hildebrandti* with a diploid number of 58 and a fundamental number of 60. The X and Y chromosomes are subtelocentric. Autosomes consist of 26 pairs of acrocentrics, a pair of submetacentrics, and a pair of metacentrics. One pair of the acrocentrics has secondary constrictions in the chromosome arm in the area next to the centromere.

REMARKS. The generic name *Rhinolophus* is from the Greek words *rhin* (nose) and *loph* (crest). The specific name *hildebrandti* refers to J. M. Hildebrandt (Peters, 1878).

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Editors of this account were GUY CAMERON and ALICIA V. LINZEY. Managing editor was JOSEPH F. MERRITT.

DAVID L. PEARL, DEPARTMENT OF BIOLOGY, 4700 KEELE STREET, YORK UNIVERSITY, NORTH YORK, ONTARIO M3J 1P3, CANADA.